Impact of National Health Insurance on the Survival Rate of Patients with Osteosarcoma in Taiwan: Review of 74 Patients

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The 2-year survival rate for high-grade osteosarcoma was 46.9% before the introduction of National Health Insurance (NHI) in Taiwan on March 1, 1995, but increased to 73.8% after the implementation of NHI. The 5-year survival rate also increased, from 37.5% to 63.6%. Between May 1990 and May 2001, 74 patients with high-grade osteosarcoma were treated at our hospital. Median age was 17 years (range, 7–63 years). Inadequate surgical margins, poor histologic response to chemotherapy, advanced stage of disease, and incomplete treatment were strongly associated with poor prognosis. Before NHI, 10 patients had incomplete treatment, mainly because of unaffordable medical fees. After NHI, only three patients had incomplete treatment, due to personal reasons. Patient survival improved dramatically with advances in multiagent chemotherapy, but it was the NHI that enabled patients to complete expensive treatment courses, including preoperative neoadjuvant chemotherapy, limb-salvage surgery, and postoperative adjuvant chemotherapy. The NHI also improved the accessibility of medical care, with more patients presenting in the early stages of disease and, as a result, it not only improved survival rate but also increased the number of patients undergoing limb-salvage surgery. We concluded that the NHI significantly improved the survival rate for patients with osteosarcoma in Taiwan.

Key Words: National Health Insurance, osteosarcoma, survival rate, Taiwan
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Osteosarcoma is the most common primary malignancy of bone, with an aggressive local pattern of growth and high metastatic potential [1]. Since the advent of multiagent adjuvant and neoadjuvant chemotherapy, patient survival has improved dramatically [2–4]. In our study, poor response to chemotherapy, inadequate surgical margin, advanced stage of disease, and incomplete treatment were all related to poor prognosis.

The government of Taiwan introduced the National Health Insurance (NHI), to cover all citizens, on March 1, 1995. Before the implementation of NHI, complete treatment for osteosarcoma was unaffordable for most patients. The average cost of complete neoadjuvant chemotherapy was NT$300,000 (US$8,571), for complete adjuvant chemotherapy was NT$700,000 (US$20,000), and for limb-salvage surgery was NT$300,000 (US$8,571). Amputations were more popular because they incurred less medical expense. The high cost of medical treatment might have hindered the accessibility of appropriate management for osteosarcoma in the early stages of the disease and, as a result, patients always presented to the hospital in the advanced stages of disease. After the implementation of NHI, these barriers were removed. Under the NHI system, all treatments are free of charge for patients with osteosarcoma. This study was conducted to analyze the influence of NHI on the survival rate for osteosarcoma.

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Materials and Methods

Between May 1990 and May 2001, 74 patients with high-grade osteosarcoma of the extremities were treated at our hospital. The median age was 17 years (range, 7–63 years). The 44 males and 30 females were followed for 2 to 13 years after osteosarcoma treatment; 32 patients were treated before the implementation of NHI and 42 after the implementation of NHI.

Lesions were located in the proximal humerus in four patients, in the proximal femur in five, in the distal femur in 40, in the proximal tibia in 17, in the distal tibia in two, in the proximal fibula in four, and in the distal fibula in two. The Enneking staging system was used throughout the study [5]. Nine patients presented with stage IIA lesions, 42 with stage IIB lesions, six with stage IIIA lesions, and 17 with stage IIIB lesions.

Treatment included limb-salvage surgery, amputation, and incomplete treatment (Table 1). Rotationplasties were regarded as amputations [6,7]. Incomplete treatment was defined as biopsy without further management, incomplete neoadjuvant chemotherapy after biopsy, or refusal of surgery after completing neoadjuvant chemotherapy. Fifty-one patients completed neoadjuvant and adjuvant chemotherapy, and their histologic response to chemotherapy was classified as "good" (≥ 90% tumor necrosis) or "poor" (< 90% tumor necrosis) [8]. Before 1995, methotrexate was used for preoperative and postoperative chemotherapy, but it was changed to doxorubicin and cisplatin postoperatively because of poor histologic response with methotrexate. After 1995, we used high-dose methotrexate, cisplatin or carboplatin, and doxorubicin for neoadjuvant chemotherapy, and we added ifosfamide postoperatively for patients with poor histologic response. The 2- and 5-year overall survival rates were calculated without considering the influence of NHI. The 2- and 5-year survival rates before and after the implementation of NHI were analyzed using the Kaplan-Meier method.

Table 1. Type of treatment for patients with osteosarcoma at Kaohsiung Medical University Hospital

Limb-salvage surgery (n = 33)	
Custom-made knee prosthesis	21
Custom-made hip prosthesis	3
Shoulder prosthesis	1
Wide excision with allograft	6
Wide excision with autoclave autograft	1
Wide excision with limb lengthening	1
Amputation (n = 28)	
Below-the-knee amputation	1
Above-the-knee amputation	10
Hip disarticulation	14
Segmental amputation	1
Rotationplasty	2
Incomplete treatment (n = 13)	
Biopsy	5
Biopsy and incomplete neoadjuvant chemotherapy	6
Biopsy and complete neoadjuvant chemotherapy	2

Results

Of the 51 patients who received neoadjuvant chemotherapy, 31 had good histologic response (60.8%) and 20 had poor histologic response (39.2%). The 2-year survival rates for patients with good and poor histologic response to chemotherapy were 100% and 40% (8/20), respectively. Nine patients had inadequate surgical margins. Six patients developed local recurrence and their 2-year survival rate was 16.7% (1/6).

Before the implementation of NHI, four patients presented with stage IIIA and 11 with stage IIIB lesions. After NHI implementation, there were two stage IIIA and six stage IIIB lesions. The overall 2-year survival rate for stage IIA disease was 100%, for stage IIB was 81%, for stage IIIA was 50%, and for stage IIIB was 0%.

Ten patients had incomplete treatment before the implementation of NHI, which decreased to three patients after NHI implementation. For patients with incomplete treatment, the 2-year survival rate was 15.4% (2/13).

The 2- and 5-year overall survival rates without considering the influence of NHI were 62.2% (46/74) and 48.1% (26/54), respectively. The 2-year survival rates before and after implementation of NHI were 46.9% (15/32) and 73.8% (31/42), respectively (Figure 1). The 5-year survival rates before and after implementation of NHI were 37.5% (12/32) and 63.6% (14/22), respectively (Figure 2).

Discussion

This retrospective study analyzed the influence of NHI on the survival rate of patients with osteosarcoma. The 2- and 5-year overall survival rates were 62.2% and 48.1%, respectively. These are lower than the rates in other reports [6,9–11]. We identified several factors that could influence the survival rate of our patients. Patients with inadequate

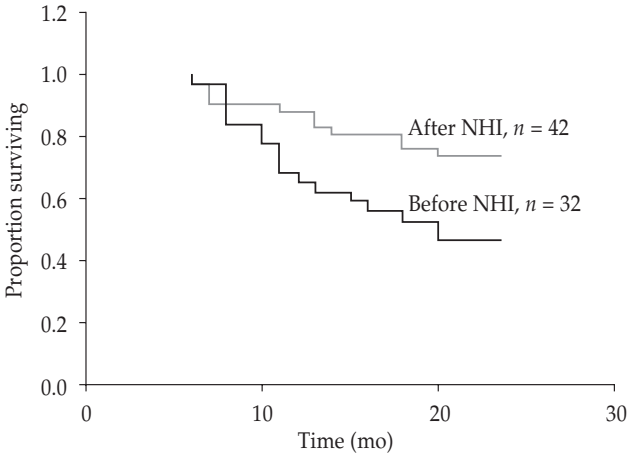

Figure 1. *Kaplan-Meier analysis of 2-year survival of patients with osteosarcoma treated before and after the implementation of National Health Insurance.*

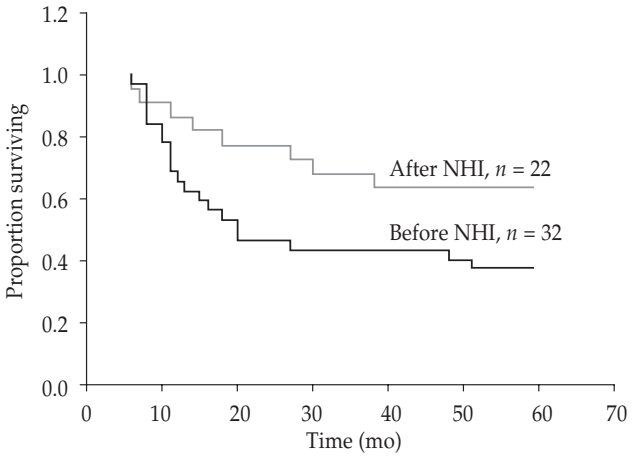

Figure 2. *Kaplan-Meier analysis of 5-year survival of patients with osteosarcoma treated before and after the implementation of National Health Insurance.*

surgical margins had a higher rate of local recurrence and their 2-year survival rate was very low. Patients with poor histologic response to chemotherapy also had lower survival rates compared to those with good histologic response. Bacci et al suggested immediate amputation for patients with inadequate surgical margins and poor histologic response to preoperative chemotherapy [6,12]. Advanced stage of disease and incomplete treatment were strongly associated with poor prognosis.

On March 1, 1995, the government of Taiwan introduced NHI to cover all citizens. This NHI program was proposed to ensure that patients have access to health care at a reasonable cost [13]. We noted a significant difference in survival rates before and after the implementation of NHI. Before NHI implementation, the 2- and 5-year survival rates were 46.9% and 37.5%, respectively. After implementation, these rates increased to 73.8% and 63.6%, respectively. Under the NHI system, all treatments for osteosarcoma are free of charge. NHI makes complete treatment accessible to patients. Before NHI implementation, only a few patients could afford to pay the expensive medical fees. More amputations were performed before NHI implementation because of the lower medical expenses and because patients presented with advanced disease that was untreatable with limb-salvage surgery. Use of the limb-salvage procedure increased significantly after NHI implementation (Table 2). We attributed this to coverage of medical expenses by the NHI, more patients presenting in the early stages of disease, improvement in the efficacy of chemotherapy, improved operative techniques, and advances in prosthetic design.

Table 2. Number of patients who received incomplete treatment, amputation and limb-salvage surgery between 1990 and 2001

	Incomplete treatment	Amputation	Limb-salvage surgery
1990	2	4	0
1991	3	2	1
1992	1	4	1
1993	1	3	0
1994	3	4	1
1995	1	3	2
1996	1	3	4
1997	0	1	5
1998	0	2	6
1999	1	1	5
2000	0	1	3
2001	0	0	5

Limb-salvage surgery became the main surgical procedure instead of amputation for treatment of osteosarcoma of the extremity in our hospital as well as many other medical centers [4,14,15].

Advances in adjuvant and neoadjuvant chemotherapy improved the survival rate dramatically for patients with osteosarcoma [2–4]. Chemotherapy remains the chief factor in curing patients with osteosarcoma and every attempt should be made to increase its efficacy [7]. However, it was the NHI that enabled patients to complete the expensive treatment courses. The implementation of NHI improved the accessibility of medical care among the general population, with more patients presenting at the early stage of disease. Therefore, a better survival rate was expected after NHI implementation. Without the NHI, despite the advances in chemotherapy and surgical technique, most patients with osteosarcoma would not receive adequate treatment, due to socioeconomic factors. We therefore conclude that the NHI had a great impact and improved the survival rate of patients with osteosarcoma in Taiwan.

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台灣全民健康保險對骨肉瘤病人存活率之影響 — 74 位病人之回顧

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自 1990 年 5 月至 2001 年 5 月，我們共治療了 74 位高度惡性骨肉瘤的病人。年齡分佈為 7 歲至 63 歲，中數為 17 歲。台灣在 1995 年 3 月 1 日實施全民健康保險，在全民健康保險實施之前，兩年存活率為 46.9% ，實施之後增加為 73.8% 。5 年存活率也從 37.5% 增加至 63.6% 。在我們的研究裡，不足夠的手術切割邊、對化療反應差、疾病較末期及治療不完整的病人，其預後都比較差。在全民健康保險實施之前，有 10 位病人無法接受完整的治療，主要是無法負擔醫療費用。全民健康保險實施之後，只有 3 位病人因為個人因素而無法接受完整的治療。化學治療的進步大大的提高了病人的存活率，而全民健康保險的實施讓病人可以無後顧之憂的完成昂貴的療程，包括術前化療、保肢手術及術後化療。全民健康保險提高了病人的就醫率而使早期骨肉瘤病人的數目增加，因而改善了骨肉瘤病人之存活率及提高了接受保肢手術的病人數。我們的結論是全民健康保險的實施明顯的改善了台灣骨肉瘤病人之存活率。

關鍵詞：全民健康保險，骨肉瘤，存活率，台灣

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